UNIVERSAL INTERFACE FOR VOICE ACTIVATED ACCESS TO MULTIPLE INFORMATION PROVIDERS

BACKGROUND OF THE INVENTION

The present invention relates to an interface for accessing data and, more particularly, to a universal interface for accessing data from one or more information systems using a wireless telephone.

As the content available from information providers expands, so does the complexity of retrieving data. For example, prior to the widespread use of electronic mail (e-mail) and alternate telecommunication systems, individuals would typically leave messages on and retrieve messages from telephone answering machines. With the numerous message centers available today, messages may be scattered over various telephone Messaging systems, electronic mail accounts, and facsimile machines. Moreover, on a daily, if not hourly, basis, individuals are storing information on, and retrieving information from, personal information management systems (PICS), electronic office managers, and world wide web sites.

The availability of these information systems renders information, formerly hard to manage and retrieve, readily accessible. Aiding the accessibility of this data is the fact that much of the data, some of which was previously available only in hardcopy, is now stored electronically and is thus searchable and retrievable. Therefore, individuals are able to access a multitude of data from multiple information providers and from the convenience of their computers.

To date, the advantages associated with the widespread availability of electronic data have not been fully realized. At least three drawbacks exist with respect to the manner in which information currently is stored. First, not all information is stored or available in the same format. For example, some information is stored as speech, others are stored as text. Second, some information is available only in text form, and would thus be inaccessible

to a traveler or a mobile user who needs to access
information using his or her wireless phone. Third, even
the if information is available in the same format and
accessible to wireless telephones, the information is not

5   centralized, but is generally offered by a number of
information providers. Thus, if one sought access to
various data, he or she would need to access numerous
information systems.

10   SUMMARY OF THE INVENTION
        A universal interface accesses one or more information
systems from a telephone, each of the information systems
being adapted to generate text data or speech data in
response to a query. The universal interface includes an

15   interface control module for receiving a sound-based command
from a user and for sending a corresponding machine readable
command to a source selected from one of the information
systems, the interface control module receiving data from ·
the source in response to the corresponding machine readable

20   command; a text-to-speech converter coupled to the interface
module for converting text data received by the interface
control module to a converted speech segment and playing the
converted speech segment for the user; and a router coupled
to the interface module for receiving speech data from the

25   source and playing a speech segment corresponding to the
speech data for the user.
        Implementations of the system may include one or more
of the following. The telephone can be wireless. The
sound-based command can come from the user's voice, or can

30   be specified using one or more telephone touch-tones.
        In another aspect, a universal interface accesses one
or more information systems from a user telephone. The
universal interface includes an input converter for
converting input from the user telephone to commands; an

35   interface control module coupled to the input converter for
receiving the commands from the input converter; determining
one of the information systems to be accessed; converting
the commands to commands recognizable by the information

system; forwarding the converted commands to the information
system; receiving data from the information system;
detecting the form of the data from the information system;
and storing information relating to a current state of the

5   system. The universal interface also includes a
speech-to-text routing switch coupled to the interface
control module for receiving data from the information
system and control data from the interface control module; a
speech-to-command converter coupled to the interface control

10   module for converting speech to commands, wherein the
speech-to-command converter coupled to the speech-to-command
routing switch to receive speech and to forward commands to
the interface control module; an output switch coupled to
the interface control module and the speech-to-text routing

15   switch for receiving speech from the speech-to-text routing
switch for receiving a control input from the interface
control module, and for forwarding speech from the
speech-to-text routing switch to the user telephone; and a
text-to-speech converter coupled to the output switch for

20   receiving text from the interface control module, converting
the text to speech, and forwarding the speech to the output
switch to deliver speech to the user telephone. The user
telephone is a mobile telephone. The input converter can be
a speech-to-command converter, a tone-to-command converter.

25   The interface control module integrates the data from the
information system periodically or manually under user
control and includes: means for retrieving data from the
information systems; means for determining antecedent
comparable relevance of the data; means for updating all of

30   the data to reflect the most recent data; means for linking
relevant data; and means for exporting the linked data to
the information system.

Implementation of the above aspect may include one or
more of the following. The information systems can include

35   two or more of the following: a calendar; a to-do list; an
address book; voice mail; e-mail; and a web site. The
interface control module integrates and synchronizes (i)a
database of a personal information manager, (ii) a database

residing on a personal digital assistant, and (iii) a
database residing in the universal interface, the universal
interface coupled to a computer on which the personal
information database resides. A computer further comprises:
5   a first input terminal for receiving data from the personal
digital assistant; a second input terminal for receiving
data from the universal interface; a sensor for detecting a
synchronization event triggered by a user requesting
synchronization of the database of the personal digital
10   assistant with the database of the personal information
manager; an electronic mail system coupled to the Internet;
and control logic coupled to receive the synchronized event
from the sensor and to transmit data, over the electronic
mail system, to the interface control module, wherein the
15   control logic updates the data in each of the databases to
reflect the most recent data entered into any database.
The synchronization information can be sent to the universal
interface in its entirety, in compressed form, or in
incremental form. The data sent from the information system
20   to the universal interface can be sent over the Internet.
The data sent can be encrypted. The output switch can be a
detector for determining whether the speech from the
speech-to-text routing switch is digital or analog; a sound
card coupled to the detector to receive digital data; a
25   first speech routing switch for receiving a control input
from the detector, and speech from the detector or speech
from the sound card; a second speech routing switch for
receiving the control input from the interface control
module and speech from the first speech routing switch or
30   speech from the text-to-speech converter, the second speech
routing switch forwarding speech to the user telephone. The
information system can include at least one of: a dual tone
multiple frequency (DTMF) driven voice mail system, a voice
driven voice mail system, an electronic mail system, a web
35   site, and a personal information manager. The system can
determine one of the following: whether the voice commands
are being received from a user telephone; the information
system to be accessed; whether the voice commands, after

4

being converted to commands, are recognizable to the
information system; whether the converted commands have been
forwarded to the information system; whether data has been
received from the information system; whether data from the
5   information system is speech or text; the state of the
speech-to-text routing switch; and the state of the output
switch.

The interface control module further includes a model
for converting commands from the telephone into commands
10   recognizable by the information system; and a translator
coupled to the input converter for retrieving the model
corresponding to the information system to be accessed and
for converting the commands to commands recognizable by the
information system. The universal interface can include
15   means coupled to the input converter for signaling that the
user telephone has received unintelligible words; means for
restarting communication to the text-to-speech converter at
a point a specified number of words back from the point at
which the communication ceased; means for forwarding the
20   first specified number of words by spelling the words out;
and means for continuing forwarding the data after the
specific number of words. The universal interface can
include means for detecting a first language in which the
commands from the user telephone are received; means for
25   detecting a second language associated with the data
received from the information system; and means for
converting the data from the information system into the
first language. The system can detect more than one
languages within a single fragment of data. A resource
30   manager for establishing conference bridges to an external
telephone having a telephone number, wherein the interface
control module detects, from the commands from the input
converter, whether a conference bridge request has been
made; the interface control module retrieves the telephone
35   number of the external telephone to establish the conference
bridge; the interface control module forwards the telephone
number to the resource manager; and the resource manager
establishes a telephone connection with the external

telephone. A facsimile manager can be used for sending facsimiles to one or more facsimile machines, wherein: the interface control module detects, from the commands from the input converter, whether a facsimile request has been made; the interface control module retrieves a telephone number of a designated facsimile machine; the interface control module forwards the data and the telephone number to the facsimile manager; and the facsimile manager faxes the data to the designated facsimile machine.

The universal interface can have a pager manager for sending pager messages to one or more pagers, wherein the interface control module detects, from the commands from the input converter, whether a pager request has been made; the interface control module retrieves data to be forwarded to the pager; the interface control module retrieves a telephone number of a designated pager to which the data is to be forwarded; the interface control module forwards the data and the telephone number to the pager manager; and the pager manager forwards the data to the designated pager.

In another aspect, a universal interface for accessing data from one or more information systems includes an input converter for receiving inputs from the user telephone and converting the inputs into commands; and an interface control module coupled to the input converter. The interface control module includes means for periodically requesting data from the information systems; means for retrieving data from the information system; means for detecting the form of data from the information system; means for converting the data that is speech to commands; means for storing the data for later access by a user telephone; and means for storing information representing a current state of the system; and further including means for receiving commands from the input converter and means for detecting which of said stored information is sought to be accessed;

a text-to-speech converter coupled to the interface control module for receiving said requested stored text from the interface control module, converting the text to speech,

and forwarding the speech to the user telephone.

The input converter can be a speech-to-command converter or a tone-to-command converter. The interface control module
5   integrates the data from the information system periodically or manually under user control, and can include means for retrieving data from the information systems; means for determining antecedent comparable relevance of the data; means for updating all of the data to reflect the most
10   recent data; means for linking relevant data; and means for exporting the linked data to the information system.

The universal interface of claim 25, wherein the interface control module integrates and synchronizes (i) a database of a personal information manager, (ii) a database
15   of a personal digital assistant, and (iii) a database residing in the universal interface, the universal interface coupled to a computer on which the personal information database resides. The computer can include a first input terminal for receiving data from the personal digital
20   assistant; a second input terminal for receiving data from the universal interface; a sensor for detecting a synchronization event, wherein the event is triggered by a user requesting synchronization of the database of the personal digital assistant with the database of a personal
25   information manager; an electronic mail system coupled to the Internet; control logic coupled to receive detection information from the sensor and to transmit data, via the electronic mail system, to the interface control module, wherein the control logic updates the data in each of the
30   databases to reflect the most recent data entered into any one database. The synchronization information is sent to the universal interface in its entirety, in compressed form, or in incremental form. The data sent from the information system to the universal interface is sent over the Internet.
35   The data sent over the Internet is encrypted. The information system can be a dual tone multiple frequency (DTMF) driven voice mail system, a voice driven voice mail system, an electronic mail system, a web site, and a

personal information manager. The system can determine whether the voice commands are being received from a user telephone; the information system to be accessed; whether the voice commands, after being converted to commands, are recognizable to the information system; whether the converted commands have been forwarded to the information system; whether data has been received from the information system; whether data from the information system is speech or text; the state of the speech-to-text routing switch; and the state of the output switch. The interface control module includes one or more models containing commands recognizable by the information system; control logic for accessing the model that corresponds with the information system to be accessed, converting control commands to commands recognizable by the information system, and forwarding the converted commands to the information system. The universal interface includes means coupled to the input converter for signaling that the user telephone has received unintelligible words; means for restarting communication to the text-to-speech converter at a point a specified number of words back from the point at which the communication ceased; means for forwarding the first specified number of words by spelling the words out; and means for continuing forwarding the data after the specific number of words. The universal interface can include means for detecting a first language in which the commands from the user telephone are received; means for detecting a second language associated with the data received from the information system; and means for converting the data from the information system into the first language. The universal interface further includes means for detecting more than one language within a single fragment of data.

In another aspect, a method provides data from one or more information systems to a user telephone by converting speech from the user telephone to commands; determining the information system to be accessed; converting the text to commands recognizable by the information system; forwarding the converted commands to the information system; receiving

data from the information system; detecting the form of the
data from the information system; converting non-speech data
from the information system into speech; forwarding the
speech data to the user telephone; and storing information
5   relating to the current state of the system.

Implementations may include one or more of the
following. The converting speech from the user telephone can
include converting speech from a mobile telephone,
converting speech to commands, or converting
10   dual-tone-multiple-frequency (DTMF) information to commands.
The data can be synchronized from the information systems by
periodically, or upon command: retrieving data from the
information systems; comparing the data to determine which
data is most recent; updating all of the data to reflect the
15. most recent data; linking relevant data; and exporting the
linked data to the information systems.

The information systems can include two or more of the
following: a calendar; a to-do list; an address book; voice
mail; e-mail; and a web site. The method includes
20   integrating and synchronizing (i) a database of a personal
information manager, (ii) a database of a personal digital
assistant, and (iii) a database residing in a universal
interface, by: receiving data from the personal digital
assistant; receiving data from the universal interface;
25   detecting a synchronization event, wherein the event is
triggered by a request for synchronization of the database
of the personal digital assistant with the database of a
personal information manager; transmitting data, via an
electronic mail system, to the interface control module; and
30   updating the data in each of the databases to reflect the
most recent data entered into any one database. The
synchronization information can be sent to the universal
interface either in its entirety, in compressed form, or in
incremental form. The data can be sent from the information
35   system to the universal interface over the Internet. The
method includes encrypting the data from the information
system before sending the encrypted data over the Internet.
The information system can include at least one of: a voice

mail system, and an electronic mail system, a web site, and
a personal information manager. The method includes storing
information relating to the current state of the system
further including determining whether the voice commands are
5   being received from a user telephone; the information system
to be accessed; whether the voice commands, after being
converted to commands, have been converted into commands
recognizable by the information system; whether the
converted commands have been forwarded to the information
10   system; whether data has been received from the information
system; whether data from the information system is speech
or text; the state of the speech-to-text routing switch; and
the state of the output switch.

The converting of text to commands recognizable by the
15   information system can include accessing one or more models
for converting commands from the telephone into commands
recognizable by the information system. The method also
includes receiving a command from the user telephone
signaling that the user telephone has received
20   unintelligible words; ceasing communication to the user
telephone; restarting communication to the user telephone at
a point a specified number of words back from the point at
which the communication ceased; forwarding the first
specified number of words by spelling the words out; and
25   continuing to forward the remainder of the data. The method
can also include detecting the language in which the
commands from the user telephone are received; detecting the
language of the data received from the information system;
converting the data from the information system into the
30   language in which commands from the user telephone are
received.

The detecting the language of the data received from
the information system further includes detecting more than
one language within a single piece of data. The method
35   includes establishing conference bridges to one or more
external telephones, by: detecting, from the commands from
the input converter, whether a conference bridge request has
been made; retrieving a telephone number of the external

telephone to which the conference bridge is to be established; forwarding the telephone number to a resource manager; and establishing, through the resource manager, a telephone connection with the external telephone, thereby opening a line of communication between the user telephone and the external telephone. The method includes sending facsimiles to one or more facsimile machines, by: detecting, from the commands from the input converter, whether a facsimile request has been made; retrieving data to be faxed; retrieving a telephone number of a designated facsimile machine to which the data is to be forwarded; forwarding the data and the telephone number to a facsimile manager; and with the aid of the facsimile manager, faxing the data to the designated facsimile machine. The method also includes sending pager messages to one or more pagers, by: detecting, from the commands from the input converter, whether a pager request has been made; retrieving data to be forwarded to a pager; retrieving a telephone number of a designated pager to which the data is to be forwarded; forwarding the data and the telephone number to a pager manager; and with the aid of the pager manager, forwarding the data to the designated pager.

In another aspect, a method accesses data from one or more information systems by retrieving data from the information system; detecting the form of data from the information system; converting the data that is speech to text; storing the data for later retrieval; and storing information representing the current state of the system.

Advantages of the invention include one or more of the following. The invention provides a seamless access to one or more information systems. More particularly, the invention provides access to multiple communication systems, some of which are text-driven, using a wireless telephone. The Universal Interface ("UI") of the invention recognizes voice commands, converts the commands into commands recognizable by the information systems, and utilizes the converted commands to access information systems and retrieve data therefrom. The UI enables an individual to

11

retrieve all of his or her information using a single device such as a wireless telephone. For instance, the individual can retrieve various information from a wireless telephone including voicemail messages, personal information manager

5   information, to do lists, electronic mail messages, and information stored on the Internet.

The UI presents the user with an abstraction of a unified mailbox (fax, e-mail, voice mail, among others) and advanced web services from a wireless telephone. It does

10   not lock the individual into one information provider, and allows the user to access multiple information providers with a single telephone call. It also provides a simple system that acts as a conduit, translating an individual's spoken or tone commands into commands recognizable by the

15· various information systems.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram illustrating a·universal interface for a mobile user.

20   Fig. 2 is a block diagram showing the universal interface for accessing the Internet.

Fig. 3 is a block diagram illustrating a first embodiment of the universal interface for processing speech commands.

25   Fig. 4 is a block diagram illustrating a second embodiment of the universal interface for processing touch-tone input.

Fig. 5 is a block diagram illustrating a third embodiment of the universal interface, with resource,

30   facsimile, and pager managers.

Fig. 6 is a block diagram showing the universal interface of Fig. 3 for communicating with a personal information manager ("PIM").

Fig. 7 is a block diagram illustrating an interface

35   control module.

Fig. 8 is a block diagram illustrating an output switch of the universal interface.

Fig. 9 is a block diagram illustrating a speech-to-text

routing switch of the universal interface.

Fig. 10 is a block diagram illustrating various ways of accessing the information systems using the universal interface.

5   Fig. 11 is a block diagram illustrating automatic data retrieval and non-real-time access to the universal interface using voice commands.

Fig. 12 is a block diagram illustrating automatic data retrieval and non-real-time access to the universal

10   interface using touch-tone inputs. Fig. 12 includes language converter and spell converter options.

DESCRIPTION

15   Referring now to Fig. 1, a universal interface 200 for mobile users is shown. A user communicates with an information system 110 using a telephone 105 which may be wireless. A universal interface 200 receives user commands from the wireless telephone 105 and converts those commands

20   into commands recognizable by the information system 110. The universal interface 200 then sends those commands to the information system 110. The information system 110 responds to the user commands and sends the responsive information to the universal interface 200. The universal interface 200

25   converts the data from the information system 110 if the data is not in a format recognizable by the wireless telephone 105. Finally, the universal interface 200 provides the data to the mobile telephone 105, thus providing the data to the user. This process of retrieving

30   information from the information system 110 through the universal interface 200 is repeated until the user retrieves all the required data.

The universal interface 200 can be used to access various data in addition to voice mails and e-mail. For

35   example, as shown in Fig. 2, the user can access Internet data such as stock quotes and weather reports from web sites 125 and 130 on the Internet 120. These data are collected and processed by a web server using intelligent web server

agent tools such as the webMethods B2B, eXtensible Markup
Language (XML) - based e-commerce solution, available from
webMethods, Inc. of Fairfax, Virginia.

5   WebMethods B2B automates data exchange between
different applications, Web sites and legacy data sources.
WebMethods B2B employs Web Interface Definition Language
(WIDL), which enables the characterization of automated
accesses to Web-enabled resources and other applications
through well-defined interfaces. By abstracting such
10   information, the applications can continue to be accessed
regardless of changes in the location, appearance, and
structure of the underlying data.

Alternatively, data may be collected and processed by a
web server using VoxML Voice Mark-up Language, available
15   from Motorola, Inc. VoxML is a mark-up language designed
specifically for voice applications on the Web. It is based
on the W3C XML standard and follows the syntactic rules of
XML. Further, VoxML offers the advantage of allowing for
the querying of web servers through the use of voice
20   commands sent over a telephone. The VoxML language can be
used to express multi-step dialogues that collect commands,
input values, and audio samples from a user, and play
recorded audio and synthesized speech back to the user.

In one embodiment, to communicate with the user, the UI
25   200 is connected to a cellular switch over one or more T1
lines. This connection allows a mobile telephone user to
dial into the cellular switch, and concomitantly into the UI
200.

The UI 200 uses the D240 T1 platform, available from
30   Dialogic Corp. of Parsippany, NJ. Connectivity to the
cellular switch can be via SS7 or E&M MF/DTMF Channel
Associated Switching, where the UI 200 can talk to the
switch using SS7 point codes. Ports can be universal, so
that they can function either as incoming or outgoing ports
35   using dynamic reallocations. The universal interface 200
may operate on a scalable and fault-tolerant computer system
such as that disclosed in copending U.S. Application Serial
No. 09/169,838, entitled "Server Pool for Clustered System,"

14

filed October 9, 1998 and commonly assigned, hereby
incorporated by reference; and as that disclosed in
copending U.S. Application Serial No. 09/169,361, entitled
"Fault Tolerant Bus for Clustered System," filed October 9,
5   1998, and commonly assigned, hereby incorporated by
reference.

Fig. 3 illustrates the internal structure of the
universal interface. If the input to the universal
interface 200 is voice, the voice is first converted to
10   computer-recognizable commands via a speech-to-command
converter 220. The converter 220 uses the Speech
Recognition Technology software, available from Nuance
Communications of Menlo Park, California. The
implementation can either be host-based or line card-based.

15   Once the speech has been converted to computer-
recognizable commands, the converted commands are then
provided to an interface control module ("ICM") 300. The
interface control module 300 receives commands from the
speech-to-command converter 220 and determines which
20   information system the user is attempting to access. It
then converts the commands into commands recognizable by the
information system 110. The interface control module 300
then establishes contact with the information system 110.
Once contact has been established, the interface control
25   module sends converted commands to the information system.
These converted commands are processed by the information
system in the same manner as if the user was accessing the
information system directly. The information system 110
receives the commands and provides data in response. The
30   data generated by the information system 110 is provided to
both the interface control module 300 and a speech-to-text
routing switch 500. The interface control module 300
determines whether the data from the information system 110
is speech or text. The interface control module 300 then
35   sends a control signal to the speech-to-text routing switch
500. This control signal indicates whether the speech-to-
text routing switch 500 should be toggled.

In a toggled state, the data from the information

system 110 is sent directly through the speech-to-text
routing switch 500 into an output switch 400. The speech-
to-text routing switch 500 is only toggled, and thus only
sends data directly to output switch 400, when the interface
5   control module 300 detects that the data from the
information system 110 is speech. The data sent directly to
output switch 400 is also sent to speech-to-command
converter 260. The speech-to-command converter 260 converts
the speech into commands and sends the commands to the
10   interface control module 300. The ICM 300 uses these
commands to determine the state of the system.

If, on the other hand, the interface control module 300
detects that the data from the information system 110 is
text, the interface control module will route the text to
15   the text-to-speech converter 230, and will send a control
signal to output switch 400, routing the speech, from the
text-to-speech converter 230 to the output of the universal
interface 200.

The text-to-speech converter 230 automatically produces
20   speech through transcription. The text-to-speech converter
contains two modules--one that processes natural language
and a second that performs digital signal processing. The
first module converts text into its phonetic equivalent.
The second converts the output of the first into speech.
25   In the alternative, a conventional voice response system can
be employed.

Also, in the embodiment the text-to-speech engine may
operate on a D240 T1 line card (which is available from
Dialogic). Also, Accuvoice's or Lernout & Hauspie's
30   TruSpeech software can be used to handle speech.

Also, in one embodiment, a VUI (Voice User Interface)
indicates various phrases that the system will recognize,
and a VAV (Virtual Assistant Voice) indicates prompts and
information from voice messages, PIM or the Web that the
35   system will play. The VUI allows the user to speak
naturally to request the information the user needs at any
level. However, when the user wants to enter information to
the speaker, the user initiates a step-by-step process to

16

interact with the system.

For example, a user's first command may take the form of:

"I would like to access my [menu item]," where menu item

5   might be calendar, to do list, address book, auto wakeup, web information, or another information system, where words not between brackets are optional.

Once the user has accessed one of the menu items, typical user commands might include:

10   <u>Play mail</u>: "[Play,Brief] [priority] [E-mail, voice mail] from [person]," where priority can be urgent or normal, among others.

<u>Address book look-up</u>: "I would like to [Find, lookup] [name]," where name is the person's name the user wants to

15   find.

<u>Call management</u>: "[I would like to] [call, dial, make a conference call to] [Name, phone number]," where name is the person's name the user wants to call.

<u>Appointment and to do list lookup</u>: "I would like to

20   [find, check] My [appointment, to do] for [date]," where date can be tomorrow or any day of the week.

When the user utters these commands to the system, the system looks for information to complete the commands. If the system cannot complete the commands, the UI 200 prompts

25   the user step-by-step for the required information. For example if the system registers the appointment keyword, but not the date, the UI 200 prompts the user for only the date. The UI 200 might state, "Which appointment date do you want me to check?"

30   Just as the UI 200 allows the user to access information, it operates similarly to allow the user to communicate information. In one embodiment, the UI 200 has a second level menu structure. This second level structure, in response to the user's commands, prompts the user for

35   information. For example, the initial user command might be: "I would like to [make, delete, update] [an entry, an item, a name]." If the user chooses to update an address entry, the UI 200 may prompt the user as follows:

"What is the business phone number of the person?"

[user speaks business phone number]

"What is the home phone number of the person?"

[user speaks home phone number]

5   In one embodiment, the UI 200 can repeat the user
information to ensure that the information has been entered
correctly. In another, the user can query the number of
entries in the address book.

The user can also enter entries to an appointment
10   calendar. In this instance, the UI 200 may prompt the user
for a date of the appointment, a beginning time of the
appointment, a duration of the appointment, and an agenda.

The user can also provide entries to the to-do list.
The UI 200 might then provide prompts for the due date,
15   priority, and agenda. If the user prompts the UI 200 to
enter an autowakeup, the UI 200 may prompt the user for the
date of the entry and the time of the entry, and the phone
number to dial at the wake-up time.

If the user prompts the UI 200 to set up a conference
20   call, the UI 200 may prompt the user as follows: "Who do you
want to conference in? Say the name of the persons or phone
number. When you are finished say 'done.'" After each time
the user speaks a name or number, the UI 200 responds with
"Got it. Who is next?" The UI 200 continues to prompt the
25   user until the user indicates that he or she is done
entering names or numbers.

In another embodiment, if an incoming call occurs
during the conference call, the UI 200 indicates to the user
that there is an incoming call. For example, the UI 200 may
30   say "[Name] is on the other line, do you want to take it?"
The user may then answer: "[I will take it, conference her
in, voice mail, (ignore virtual assistant)]."

Just as the user can update information, he or she can
also delete or modify entries. If the user attempts to
35   delete information, the UI 200 may prompt the user to verify
the request prior to deleting the entry. And, just as in
conventional systems, certain use preferences such as
whether or not to inquire before deleting may be stored in

18

memory.

Further, once the user has prompted the UI 200 to perform a particular function, the UI 200 can prompt the user to ensure that the user does not want to repeat a

5   similar function. For example, once the user has prompted the UI 200 to enter an item into the to-do list, the UI 200 might prompt the user to determine if the user wants to add another entry.

In one embodiment, the UI 200 has additional functions

10   related to the playing or briefing of messages. These commands include: save, delete, play, forward, reply, next, previous, higher volume, lower volume, skip forward, skip backward, faster, slower.

In Fig. 3, the text-to-speech converter 230 routes

15   speech to the output switch 400. The interface control module 300 sends a control signal to the output switch 400. In a non-toggled state, the output switch 400 receives the output of the text-to-speech converter 230. In a toggled state, the output of the output switch 400 receives the

20   output of the speech-to-text routing switch 500.

If the data from the information system 110 is speech, it is routed directly to the output of the universal interface 200. If, on the other hand, the data from the information system 110 is text, the data is converted to

25   speech via the text-to-speech converter 230 and is then routed through the output switch 400 to the output of the universal interface 200.

Fig. 4 is similar to Fig. 3, except that the input to the universal interface 200 handles touch-tone inputs rather

30   than voice inputs. Therefore, the speech-to-command converter 220 of Fig. 4 is replaced with a tone-to-command converter 250 of Fig. 4. The tone-to-command converter 250 converts touch-tone inputs from a telephone of the user into commands. The commands are presented to the interface

35   control module 300. The interface control module 300 then functions as described above.

Fig. 5 illustrates a universal interface with resource, facsimile, and pager managers. These managers are

accessible from the web.

The universal interface 200 accepts touch-tone from the user's telephone. This tone is converted subsequently to commands through the tone-to-command converter 250. As in
5   Fig. 4, the output of the tone-to-command converter 250 is then sent to the interface control module 300. The universal interface 200 functions in the same manner as the universal interface 200 of Fig. 4, except that the universal interface 200 of Fig. 5 can support resources, facsimiles
10   and pagers through a resource manager 270, a facsimile manager 280, and a pager manager 290. These managers interface with an external telephone 275, a facsimile machine 285, and a pager 295, respectively.

The pager manager 290 can receive pages from another
15   user, and can also page one or more external pagers 295. The pager manager 290 sends the information received from the pager 295 to the interface control module 300. The pager manager manages pager and message delivery queues. The UI 200 may use a native NT file system or CIFS virtual
20   file system to manage system wide pager and dial-out queues. See, for example, copending U.S. Application Serial No. 09/169,360, entitled "Shared-Everything File Storage for Cluster System," filed October 9, 1998, and commonly assigned, hereby incorporated by reference.

25   Similarly, the facsimile manager 280 receives facsimile messages from another user, and sends faxes to the facsimile 285. The fax manager manages the queues for facsimiles. It keeps track of the number of facsimile resources available in the system, maintains a list of outgoing faxes to be
30   delivered, and incorporates a retry mechanism in case of an error.

The UI 200 has a fax-only mailbox so that callers can deposit directly a fax into their recipient's mailbox without first ringing the handset of the recipient. A
35   caller can dial the fax-only mailbox number and press a start button on his or her fax machine. This feature is referred to as walk-away-fax.

The resource manager 270 assigns various conference

resources in a multi-node system, where a multi-node system can consist of multiple UI's within a single UI, or can consist of a number of UI's connected in tandem. The resource manager 270 provides inter-node time slot

5   management for conference calls.

As with the pager manager 280, the facsimile manager 280 and the resource manager 270 communicate data from the external facsimile machine 285 and telephone 275, respectively, to the interface control module 300.

10   Information from all three managers, 270, 280 and 290, becomes available to the interface control module 300 for later access by the user. Although Fig. 6 illustrates an embodiment in which the user communicates via a touch-tone pad, resource managers, facsimile managers and pager

15   managers can also be incorporated into a system in which a user communicates via speech.

To support the management of facsimiles, the universal interface 200 must contain facsimile drivers. The UI 200 provides fax capabilities by integrating facsimiles through

20   the use of the CP12 board available from Dialogic. The board and drivers may be interfaced through a fax application manager.

Fig. 6 illustrates the universal interface with personal information manager PIM synchronization

25   capabilities. The PIM 265 manages a user's address book, calendar, and to-do list.

The address book contains entries with fields such as name, title, company address, business phone, home address, home phone, mobile phone, facsimile number, e-mail address,

30   web page address and notes.

The calendar keeps track of appointments. It has features such as subject/agenda, location, date/time, and appointment length.

The to-do list is used to keep track of tasks that need

35   to be accomplished. Each to-do list entry has fields such as subject/agenda, priority, due date/time, and reminder notes. The UI can page, call, or send e-mail with to-do list contents.

In the embodiment of Fig. 6, the user communicates with
the universal interface 200, and therefore with the
information systems, via a touch-tone pad. This embodiment
differs from the embodiment of Fig. 4, in that the
5   information system is a computer 262, to which a PIM 265 can
be connected.

In most PIM's, such as the "PalmPilot" or "Palm III,"
available from 3Com Corporation of Santa Clara, California,
a synchronization process takes place from time to time with
10   the personal computer 600. Using the "PalmPilot" as an
example, this synchronization process is accomplished by
placing the "PalmPilot" in a cradle, which is connected to
the computer 252 through a serial cable; and pressing a
"HotSync" button on the cradle. The synchronization process
15   sends information from the "PalmPilot" device to the
computer 262, thereby synchronizing databases on both units.

In one embodiment, the UI 200 synchronizes the PIM 265
with the universal interface 200 at the same time the user
is synchronizing the PIM 265 with computer 262. In this
20   embodiment, the UI 200 senses or intercepts the
synchronization signal. When the UI 200 detects that the
PIM 265 is requesting synchronization, the UI 200
communicates with the computer 262 and imports the
synchronization information therefrom. In this way, a
25   remote server connection is made any time there is a
synchronization event, thereby making the most current
synchronized database available via a wireless phone.

Alternatively, the universal interface 200 can
periodically synchronize its database with the computer 262.
30   In this embodiment, the universal interface 200 periodically
communicates with computer 262 and requests information on
the last PIM 265 synchronization. If the computer·262
indicates that it has synchronized with the PIM 265 since
the last communication with the universal interface 200, the
35   universal interface 200 sends control logic to the computer
262 to retrieve the most recent data.

The personal information synchronization can take place
over the web. Further, the data sent via the Internet can

22

be encrypted. Additionally, the data may be sent in compressed form or in incremental form when only new or updated data is transmitted.

5   Fig. 7 illustrates in block diagram form, the structure of the ICM 300. In the embodiment of Fig. 7, control code 310 receives as input commands from the speech-to-command converter 220 of Fig. 3 or the tone-to-command converter 250 of Fig. 4. The control code 310 detects the type of information system 110 to be accessed, and then accesses a
10   model 1 through N 320, 330, which corresponds with the particular information system 110. Each of the model 1 through N 320, 330 provides a mapping of the input commands to commands recognized by the information system 110. The control code 310 looks up the chosen model, 320 or 330, the
15   information system command that responds to the user input. The control code 310 then sends the command to the information system 110 and retrieves information therefrom.

     Figs. 8 and 9 illustrate in more detail the output switch 400 and the speech-to-text routing switch 500,
20   respectively. The output switch 400 shown in Fig. 8 has three inputs. The first input receives speech from the speech-to-text routing switch 500 (Figs. 4-5). This input represents speech data retrieved from the information system 110. The second input receives the speech output of the
25   text-to-speech converter 230. This input is used by the output switch 400 if the data from the information system 110 is text which needs to be converted to speech by the text-to-speech converter 230. The third input to the output switch 400 is a switch control. If the interface control
30   module 300 detects that the data coming from the information system 110 is text, it sends a switch control signal to switch 440, toggling switch 440 and allowing the text from the information system 110, after being converted by the text-to-speech converter 230, to flow to the output of the
35   universal interface 200. Otherwise, if the interface control module 300 detects that the data from the information system 110 is speech, then the interface control module 300 sends a switch control signal to the switch 440

23

which sets the switch 440 in an untoggled state, thus
routing the speech from the information system 110 through
to the output of the universal interface 200.

When the speech first enters the output switch 400, it

5   is received by a detector 410. The detector 410 detects
whether the speech is analog or digital in form. If the
speech is in an analog form, the detector 410 sends the
speech to switch 430. It also asserts the switch control
input to switch 430, throwing the switch to a position that

10   allows the speech input into switch 430 to be sent to the
switch 440. If, on the other hand, the speech received by
the detector 410 is digital, the digital speech is sent to
sound card 420. At the same time, the detector 410 sends a
switch control input to the switch 430, routing the output

15   from sound card 420 through to switch 440.

Fig. 9 illustrates the speech-to-text routing switch
500. This speech-to-text routing switch 500 receives data
from the information system 110. This data can either be in
text or speech format. If the data from the information

20   system 110 is in speech format, the speech-to-text routing
switch 500 routes the speech directly to the output switch
400. If, on the other hand, the data from the information
system is in text format, the speech-to-text routing switch
500 is opened. In this instance, the text data is not

25   routed to the output switch 400 through the speech-to-text
routing switch 500.

The interface control module 300 controls the state of
the switch 520 in the speech-to-text routing switch 500. In
the event that the interface control module 300 detects that

30   the data from the information system 110 is speech, it sends
a control signal to the speech-to-text routing switch 500,
throwing the switch 520 to a closed state. When the
interface control module 300 detects text data from the
information system 110, it sends the control signal to the

35   speech-to-text routing switch 500, to maintain the switch
520 in an open position. When the data from information
system 110 is text, the text from the information system 110
is received by the interface control module 300 and routed

24

through the text-to-speech converter 230 to the output
switch 400. This text, which has been converted to speech
by the text-to-speech converter 230, is then sent to the
output of the universal interface 200.

5   Turning now to Fig. 10, different methods in which a
user can access various information systems 110 and 650,
through various universal interfaces 200 and 620 are
illustrated. In one embodiment, the user can access the
information system 110 directly through a universal
10   interface 200 through the use of a wireless telephone 105.
In another embodiment, the universal interface 620 resides
in a telephony server 610. In this embodiment, the
universal interface 620 can access an information system
650. The universal interface 620 retrieves information from
15   the information system 650 periodically. When the user
communicates with the telephony server 610 through a
wireless telephone 670, the user can retrieve previously
retrieved information from the information system 650. This
previously retrieved information is stored in memory 660.
20   Alternatively, and in a third embodiment, the user can
interface with the telephony server 610 to retrieve
information in real-time. In this embodiment, the telephony
server 610 acts as a conduit to allow connection between the
wireless telephone 670 and the universal interface 200.
25   From the user's standpoint, the operation is the same as if
the user had accessed universal interface 200 directly.

          As previously discussed, the universal interface 200
can operate in a nonreal-time mode. This mode is
illustrated in Figs. 11 and 12. The interface control
30   module 300 communicates with one or more information systems
110 and 710. The interface control module 300 periodically
retrieves data from these information systems. The
interface control module 300 then stores the retrieved data
in an internal or an external memory 660. If data retrieved
35   from the information system 110 or 710 is in speech format,
the interface control module 300 converts the speech to text
before storing the data in memory 660. Once the data is
stored in memory 660, the user can access previously stored

data at any time. In the particular embodiment illustrated
in Fig. 12, the user may access the universal interface
using a touch-tone pad. In this case, the touch-tone input
is converted to text via a tone-to-command converter 250 and

5   is then input into the interface control module 300. The
interface control module 300 interprets the commands from
the user and retrieves the appropriate data from memory 660.
Because the data in memory 660 is in text format, the
interface control module 300 sends the data to a text-to-

10   speech converter 230. This text-to-speech converter 230
converts the data into speech and provides the data in
speech format to the user.

The embodiment of Fig. 11 operates similarly to that in
Fig. 12 except that the UI 200 is designed to receive speech

15   as input.

In one embodiment of the invention, the universal
interface contains a language converter 720 (Fig. 12), which
has the additional capability of translating electronic mail
messages, and other data, which is stored in a different

20   language, such as Spanish, French, among others. The
language converter 720 first sends the first few lines of an
e-mail or message to a module called the "language
identifier." The language identifier analyzes the words
used by looking them up in a list of often used and typical

25   words for all languages under consideration. For example,
words often used in the English language might include
"the," "and," and "in." The converter tallies the results,
and determines the appropriate language.

If the language used is different from that spoken by

30   the user (whose language can be ascertained by the language
identifier), then the language converter 720, before
communicating the language to the user, converts the data to
the user's language.

The universal interface may also monitor the language

35   in which the data is stored. If the language converter 720
detects a change in the language, the universal interface
200 back-tracks a specified number of words and attempts to
provide information in the language spoken by the user.

This process of changing languages mid-stream can occur
multiple times within one transmission.

     In another embodiment, the universal interface accesses
a spell converter 720 which spells out words that the user

5   indicates are unintelligible. This embodiment compensates
for pronunciation errors by the text-to-speech converters.
These errors may occur because either the correct
pronunciation falls into some grammatical exception or
because the text being converted contains typographical

10   errors.

     In this embodiment, the universal interface receives a
command such as a pound(#) touch-tone from the user
telephone indicating that the user has received
unintelligible words. The universal interface 200 halts the

15   text-to-speech converter 230 and restarts communication at a
retry point a specified number of words back from stopping
point where the communication had ceased. When the
universal interface 200 resumes communication, it accesses
the spell converter 730 which tracks the text that was sent

20   to the text-to-speech converter. The spell converter 730
provides, to the Universal Interface, the spelling for a
predetermined number of words. The universal interface 200
then starts out by spelling a predetermined number of words
from the restart point. The universal interface 200 then

25   resumes communication at or near the same point where the
user had indicated that the speech was unintelligible. Both
the language converter 720 and the spell converter 730 may
be modules internal to the interface control module 300.

     As discussed above, depending upon the user's needs,

30   the universal interface 200 can retrieve information from
one or more information systems. These systems may include,
for example, electronic mail, voice mail, websites, or
personal information managers.

     Regardless of the information system type, the

35   universal interface 200 operates with one or more servers to
provide the appropriate access. An e-mail server sends and
receives messages using Internet Message Access Protocol
(IMAP4) and Post Office Protocol/Simple Mail Transfer

27

Protocol (POP3/SMTP) protocols, where SMTP is the Internet
standard for transmitting and forwarding messages, POP is
the Internet standard for retrieving e-mail, and IMAP is the
"next generation" Internet standard for retrieving e-mail.
5   The e-mail server also services Internet voice and fax
messages.

In one embodiment, the e-mail server uses the same
message store that is used for voice messages. Further,
shared messages are not replicated.

10   IMAP stands for Internet Message Access Protocol. It
is a method of accessing e-mail or bulletin board messages
that are kept on a mail server. It permits a "client" e-
mail program to access remote message stores as if they were
local. E-mail stored on an IMAP4 server can be manipulated
15   from a desktop computer at home, a workstation at the
office, and a notebook computer while traveling, without the
need to transfer messages or files back and forth between
these computers. IMAP's ability to access messages (both
new and saved) from more than one computer is important as
20   reliance on electronic Messaging and use of multiple
computers is a common mode of operation for the mobile user.
IMAP4 supports an offline access to the message store
followed by a resynchronization of the message store with
the server.

25   The IMAP4 protocol includes operations for creating,
deleting, and renaming mailboxes; checking for new messages;
permanently removing messages; setting and clearing flags;
server-based RFC-822 and MIME parsing, and searching; and
selective fetching of message attributes, texts, and
30   portions thereof for efficiency. Note that MIME is an
Internet standard for Messaging formatting. MIME allows for
the attachment of various files to e-mail messages. These
attachments might include text, voicemail, or faxes.

The e-mail directory server utilizes a X.500 directory
35   that stores user addresses, provides routing information,
and unifies e-mail components in the environment. The e-
mail directory server uses the following protocols to
provide a distributed directory service: LDAP (Lightweight

28

Directory Access Protocol) for client access--allows for the
publishing and access of directories such as phone
directories, DAP (Directory Access Protocol) for message
routing information, DSP (Directory System Protocol) for
5   forwarding requests to remote directory servers and
obtaining results, DISP (Directory Information Shadowing
Protocol) for replicating information between servers, and
HTTP (one of two standard foundations for the World Wide
Web) for access from Web browsers. The Web/Directory
10   gateway facilitates access to LDAP and X.500 Directory
information from a standard web browser, and utilities to
import and export data to other applications, including user
registration from other mail systems.
        Mailbox management must be reconciled between the voice
15   and e-mail mailbox utilities. The E-mail X.500 mailbox
structure and name service must be preserved, as they are
integral to e-mail standards and protocols. In one
embodiment, the voice mailbox tools are used as the primary
mailbox management utilities. Voice mailbox creation would
20   be exported to the X.500 e-mail box schema. Although there
will be replication of the mailbox data between the voice
and e-mail boxed structures, the message store is common
between the voice and e-mail servers. Further, event
notifications may be provided for messages received while
25   the user is in a session.
        Another server may service the world wide web. Using
Active X and Java applets and script technology, one can
access information over the Internet using a standard web
browser. The information accessible over the web includes
30   information associated with Internet web sites such as
stock, weather, business information, as well as
synchronized information from the user's PIM, such as
calendar, address book and to-do list.
        The web server uses COM interfaces to retrieve PIM
35   information, e-mail, voice mail and fax messages. These
operations may be performed locally on the web server.
        In an embodiment which handles voice mail systems, the
UI 200 provides an interface to various legacy voice mail

29

systems such as systems from Octel or Centigram. The legacy
system may forward voice and fax messages to the UI 200
using VPIM (Voice Profile for Internet Messaging). VPIM is
based on MIME, an Internet standard for message formatting,
5   which allows voice and fax mail systems to exchange messages
over the Internet.

　　　The UI may have fewer voice mail features than the
legacy systems. In such a case, the UI maps strings and
features that are supported and accesses data according to
10   its perhaps limited abilities.

　　　The UI provides the use of a voice or DTMF dial-out to
the legacy system while preserving the virtual assistant
functionality. The user can change parameters of the
universal interface, and can also expand the UI
15   capabilities, through either the telephone or the Web.
Configuration changes over the web may be either menu or
form driven. Changes over the phone may be menu driven.

　　　It should be noted that although the input to the
universal interface 200 has been illustrated as either tone
20   or speech, the invention can accept as input either speech,
tone, or both speech and tone. Further, while the invention
has been shown and described with reference to an embodiment
thereof, those skilled in the art will understand that the
above and other changes in form and detail may be made
25   without departing from the spirit and scope of the following
claims.